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Yamazoe

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(54) **IMAGE FORMING APPARATUS INCLUDING A COLLECTING PORTION INSIDE GUIDE MEMBERS TO COLLECT AND STORE LIQUID DROPLETS**

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G03G 15/00 (2006.01)

(52) **U.S. Cl.** **399/92**; 399/97; 399/401; 399/405

(58) **Field of Classification Search** 399/92, 399/97, 401, 405

See application file for complete search history.

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(57) **ABSTRACT**

An image forming apparatus includes a transfer unit, a fixing unit, a discharging unit, and multiple guide members. The transfer unit transfers an image onto a transfer sheet. The fixing unit fixes the image to the transfer sheet by application of heat and conveys the fixed transfer sheet to a further downstream portion of the image forming apparatus. The discharging unit discharges the transfer sheet to an external portion of the image forming apparatus. The multiple guide members form a sheet conveyance path that has first and second paths including a hollow portion defined by the multiple guide members to enable an air current generated during image forming to pass therethrough.

19 Claims, 11 Drawing Sheets

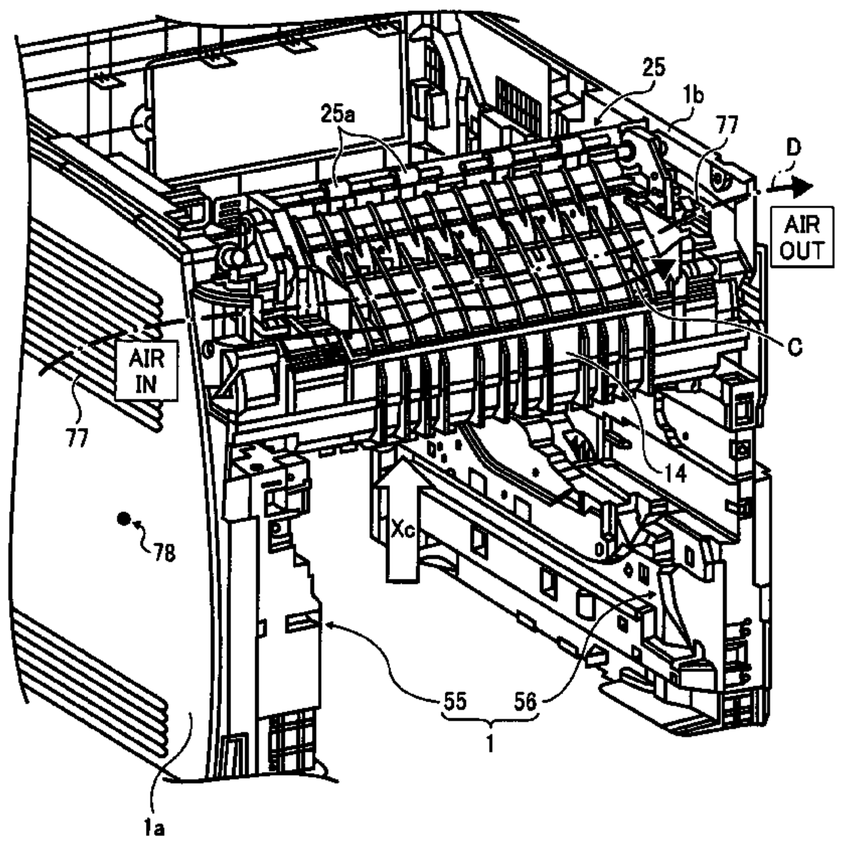


FIG. 1

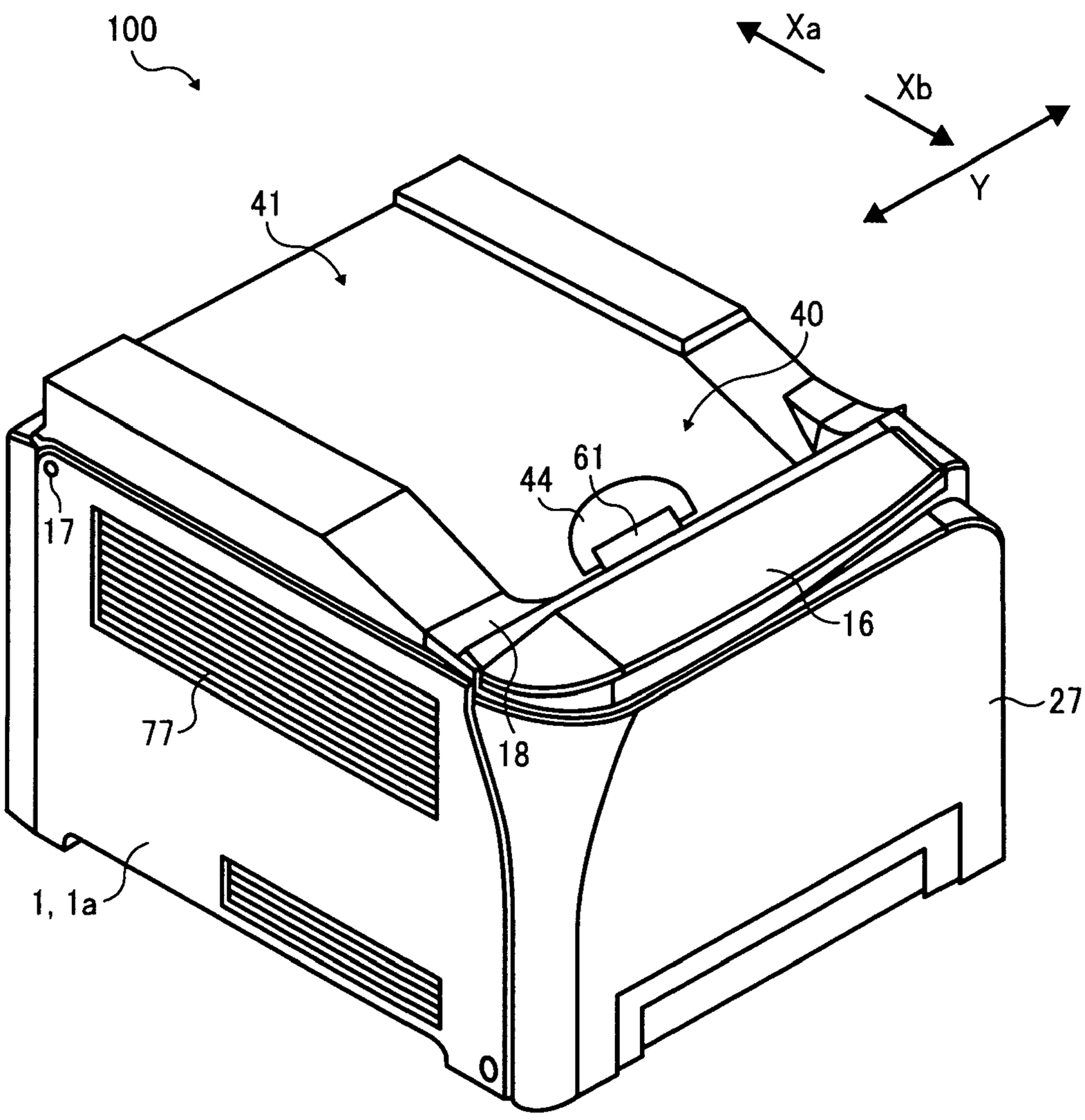
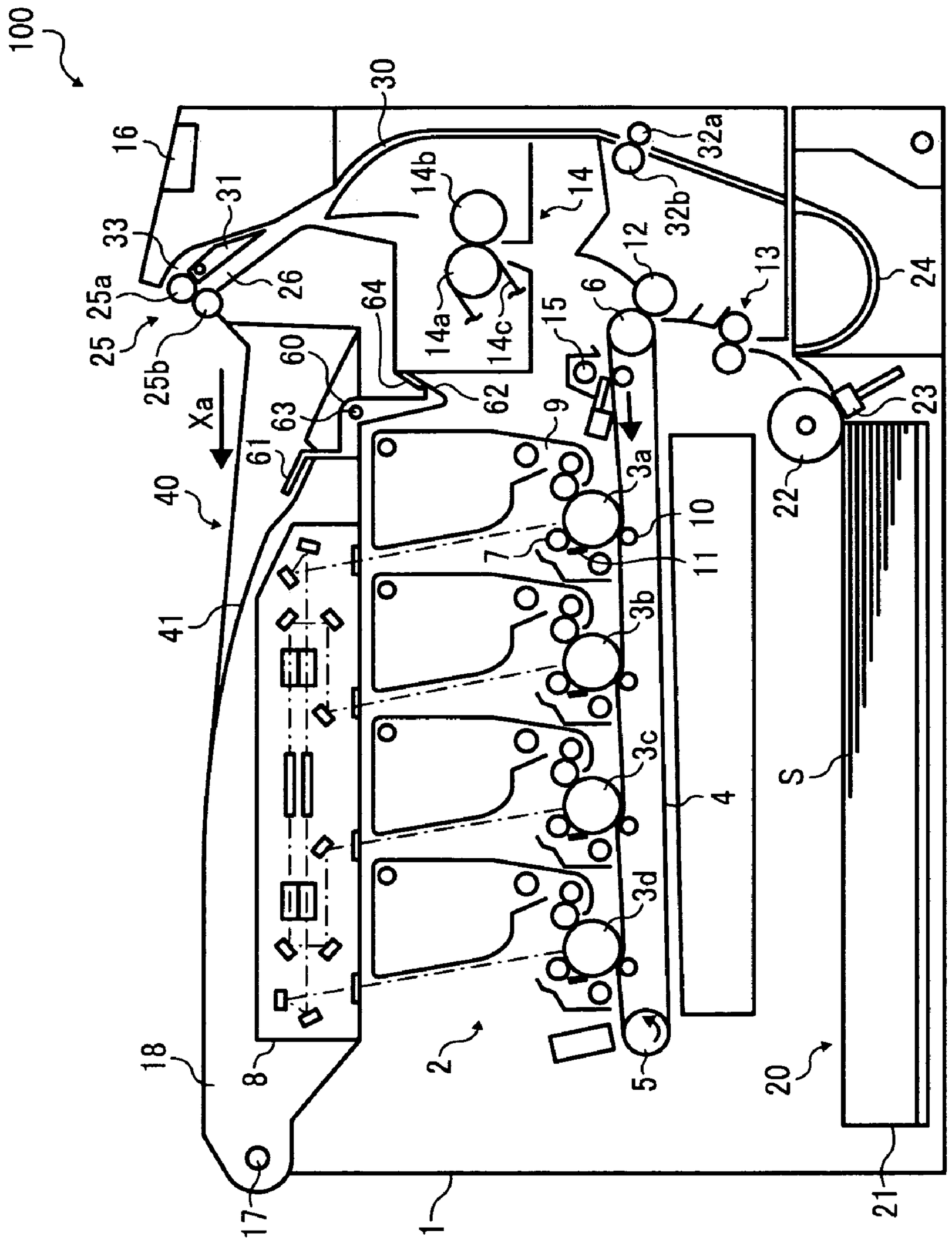


FIG. 2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2b
32b
12
13
24
15
6
9
3a
3b
3c
3d
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1
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FIG. 3

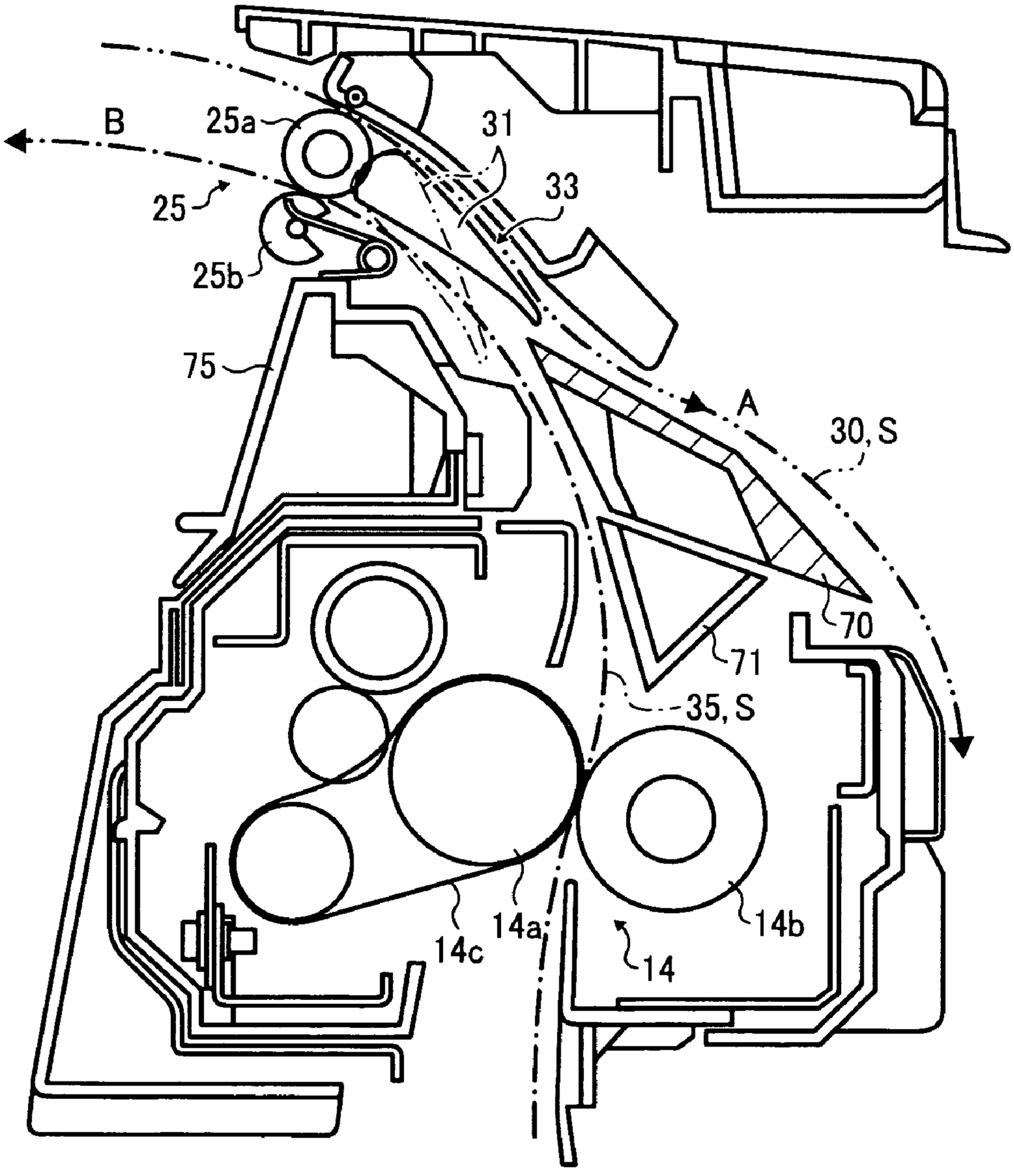


FIG. 4

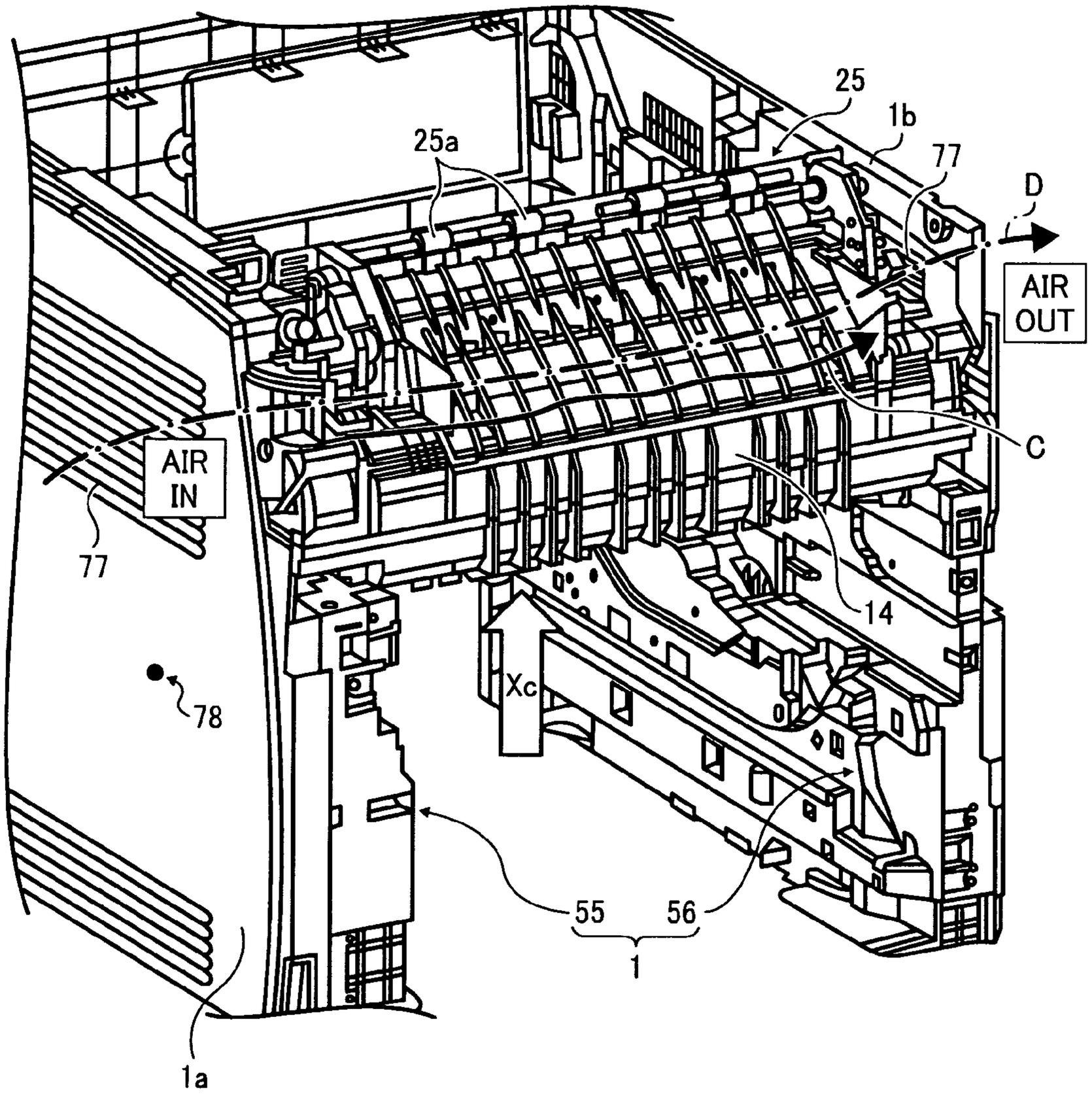


FIG. 5

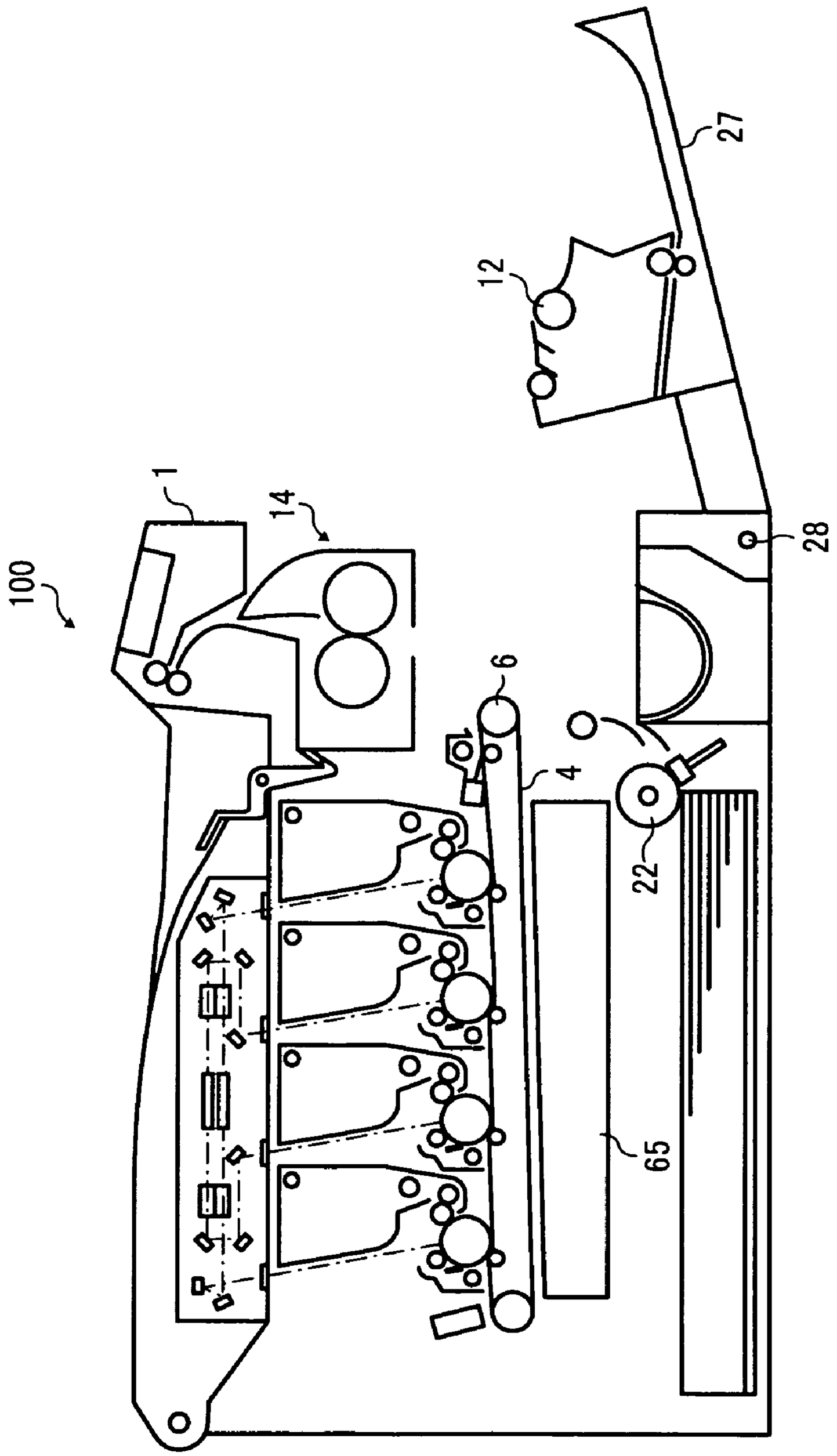


FIG. 6

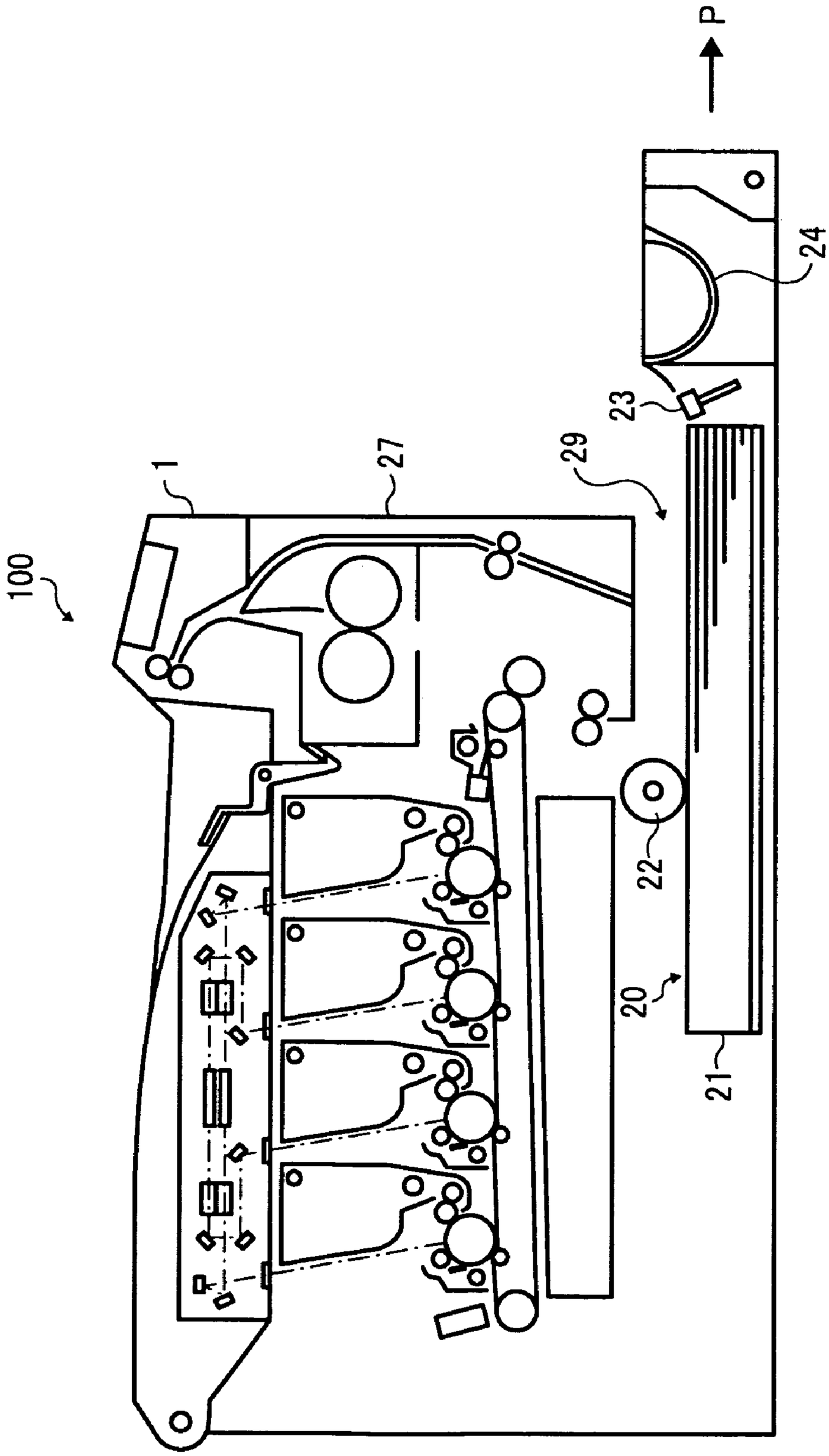


FIG. 7B

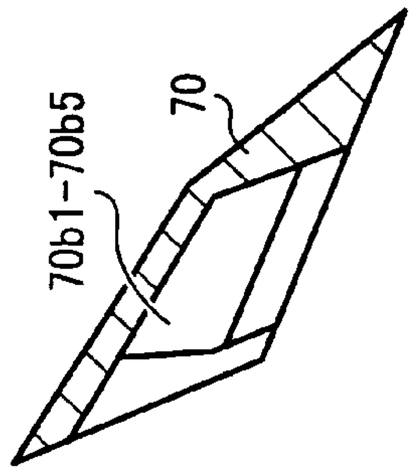
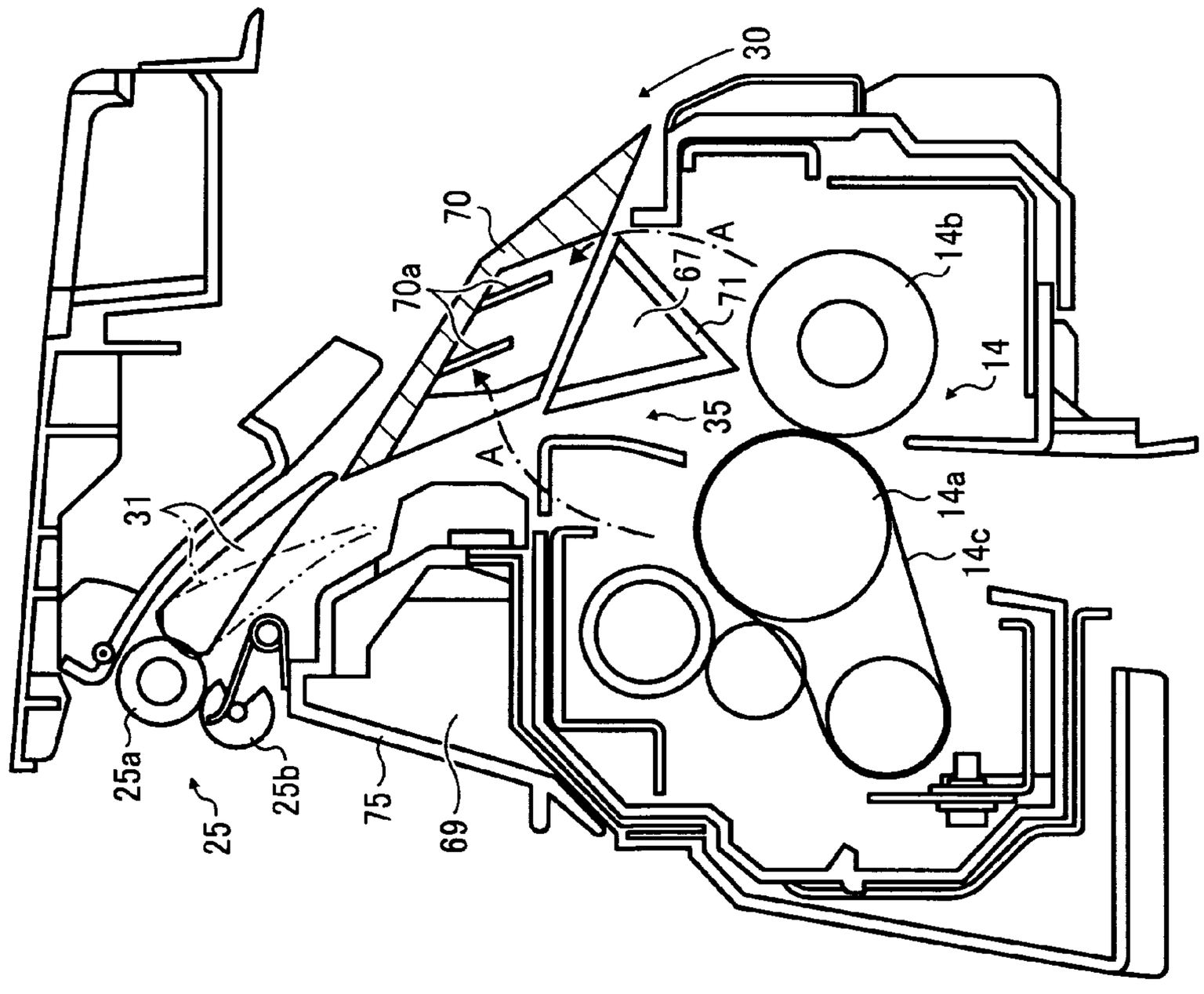

70b1-70b5
70

FIG. 7A


30
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14b
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31
14a
14c
25a
25
25b
75
69

FIG. 8

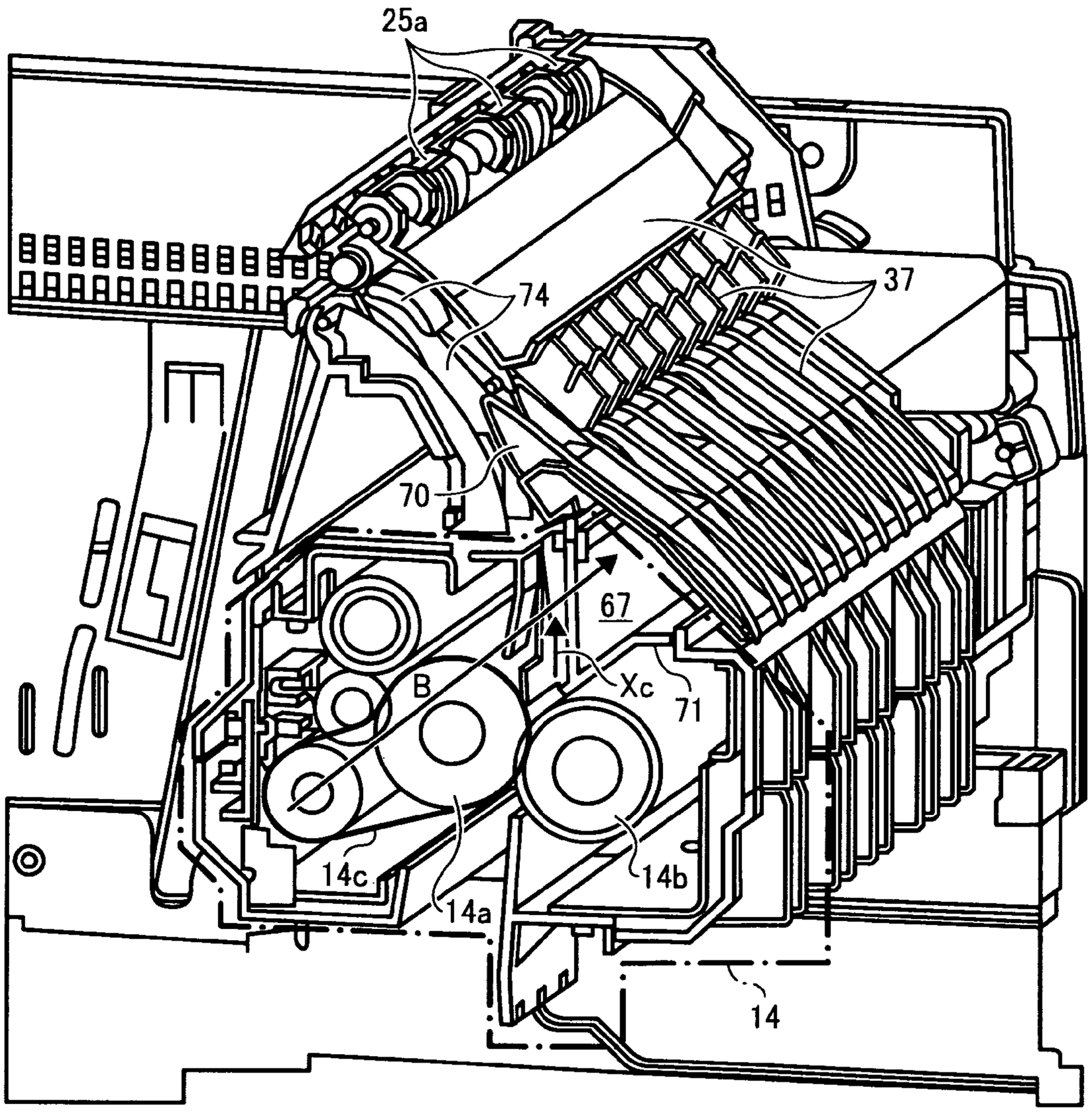

FIG. 9A

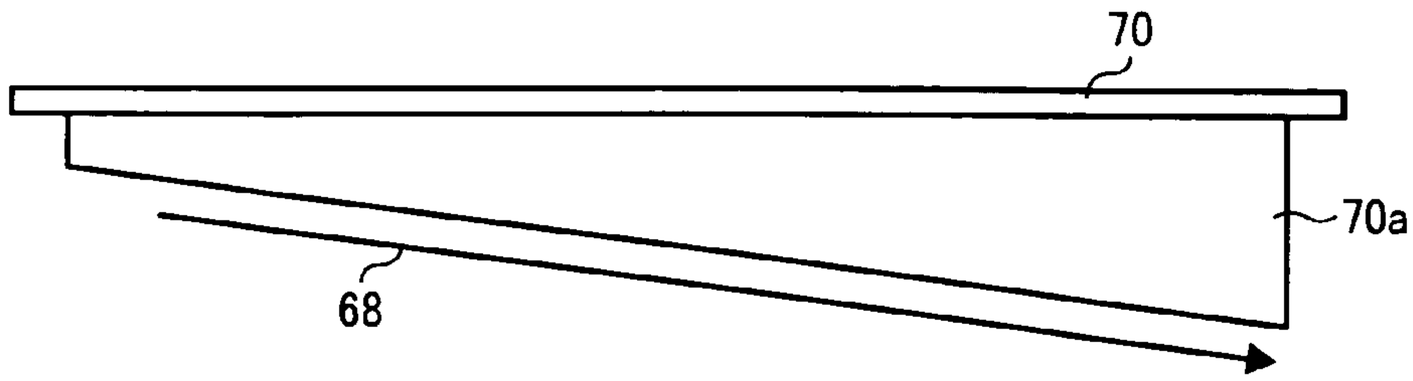

FIG. 9B

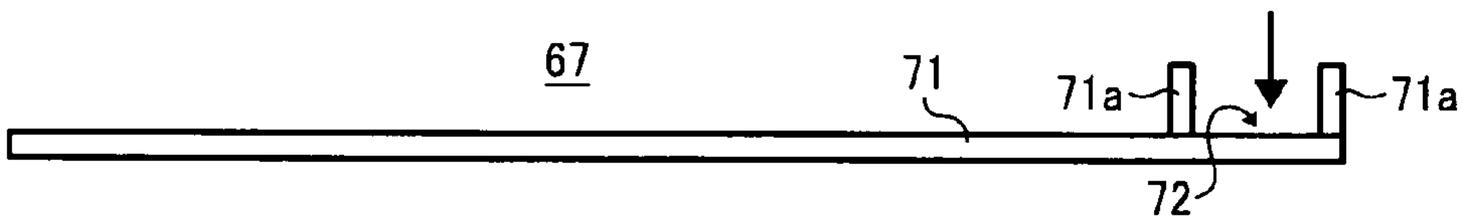

FIG. 9C

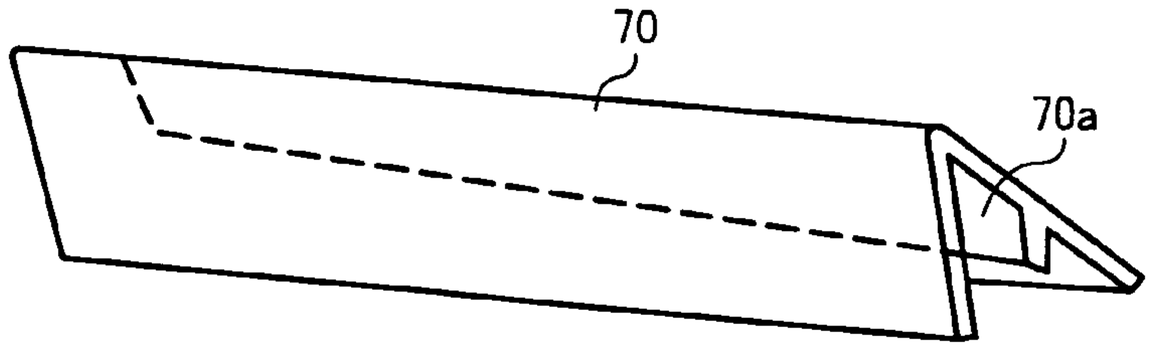

FIG. 9D

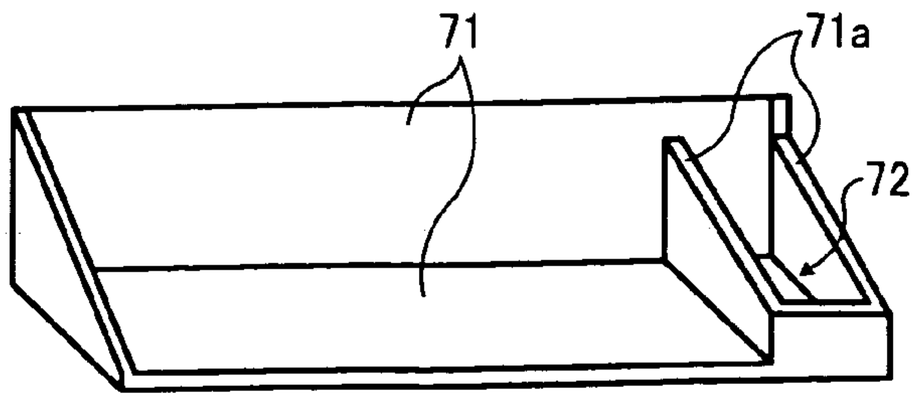

FIG. 10A

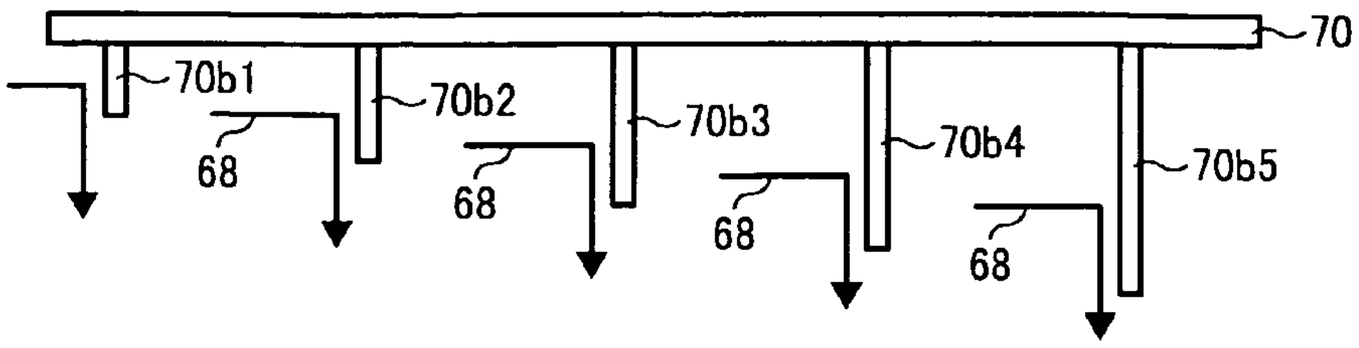

FIG. 10B

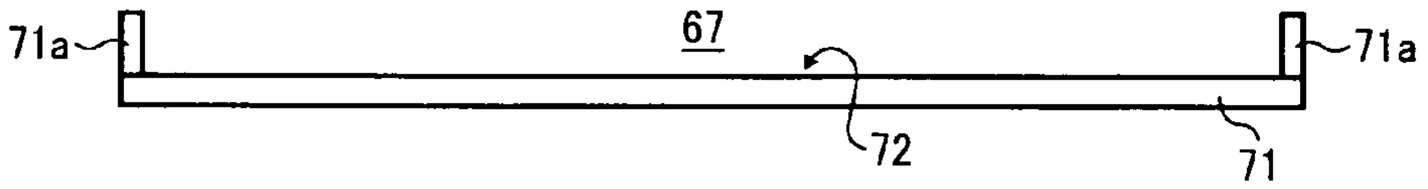

FIG. 10C

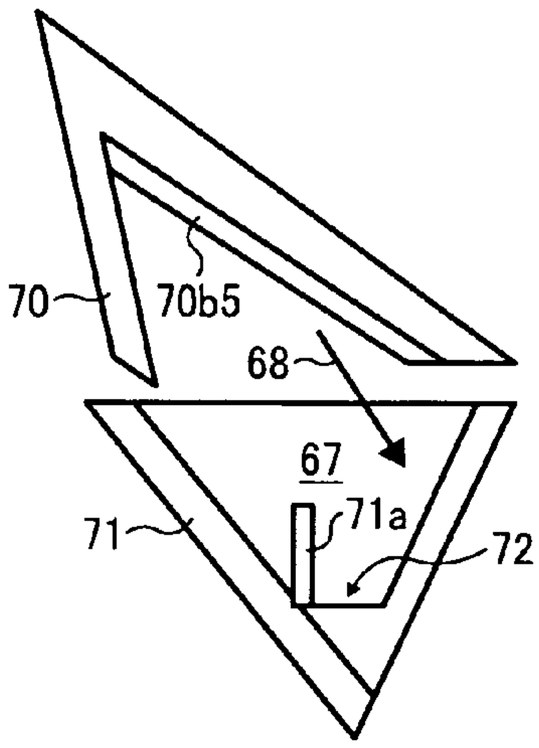

FIG. 10D

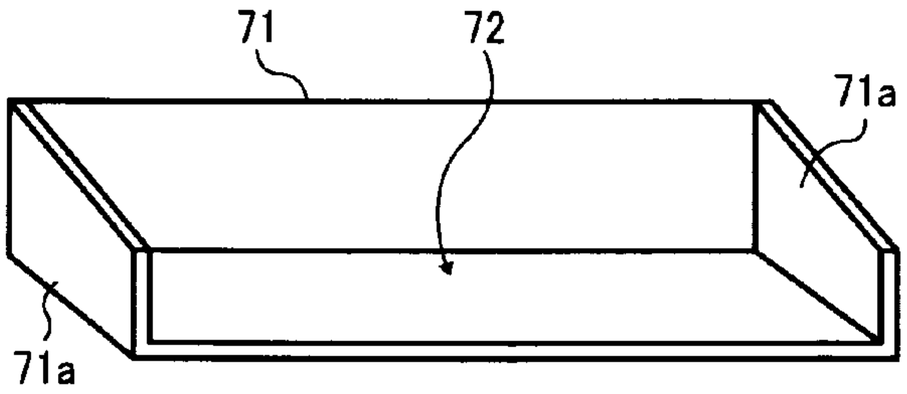

FIG. 10E

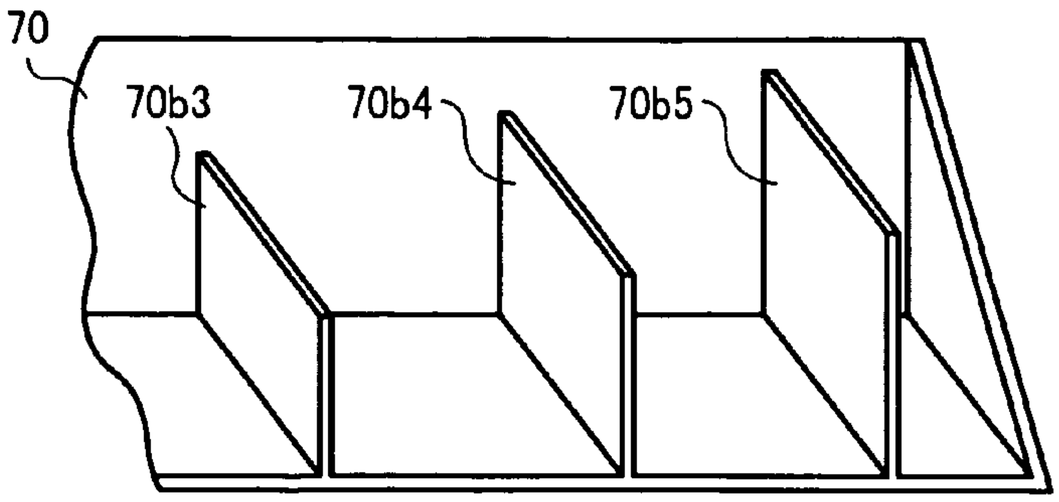

FIG. 11

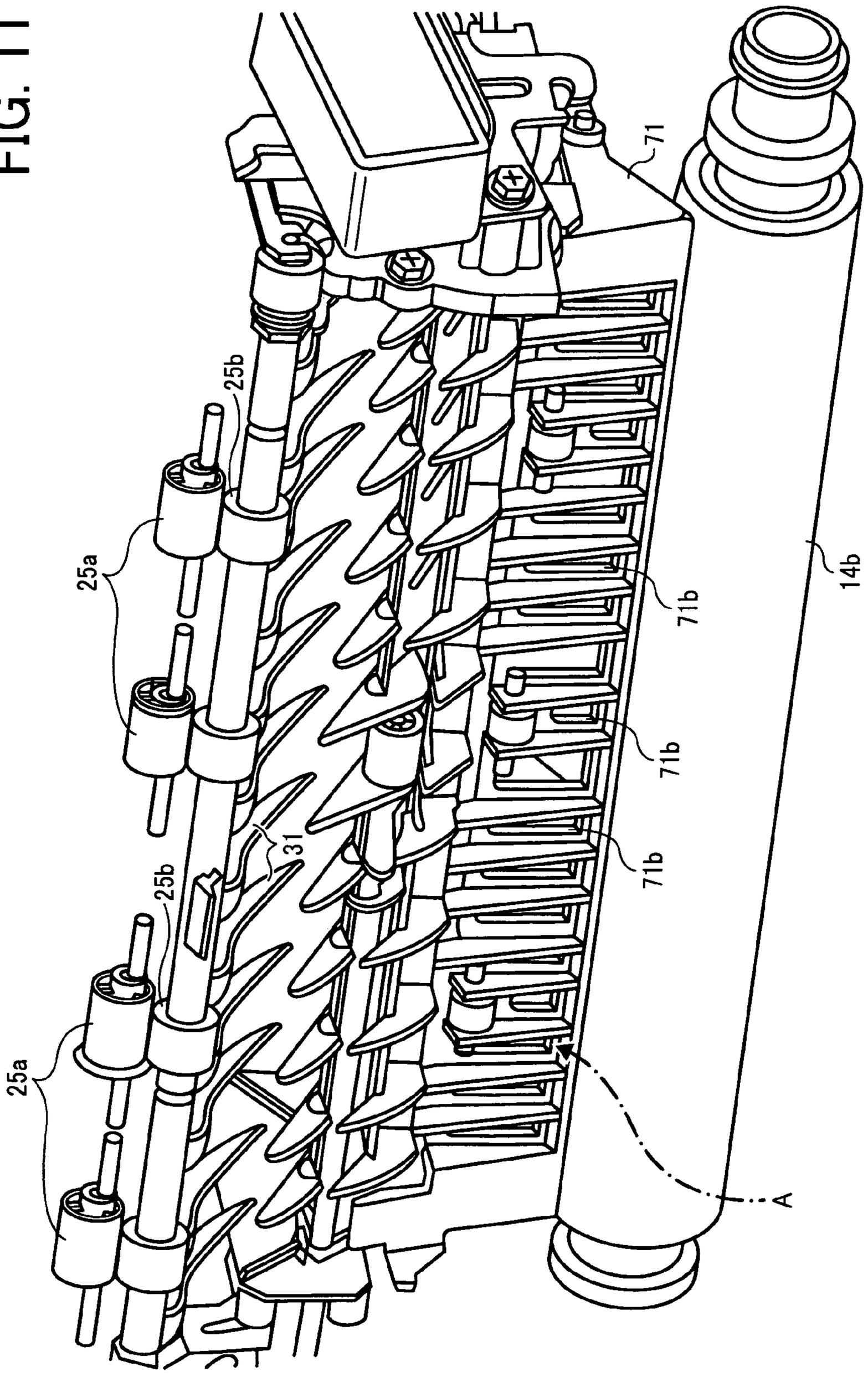

IMAGE FORMING APPARATUS INCLUDING A COLLECTING PORTION INSIDE GUIDE MEMBERS TO COLLECT AND STORE LIQUID DROPLETS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention claims priority pursuant to 35 U.S.C. §119 from Japanese Patent Application No. 2008-173431, filed on Jul. 2, 2008 in the Japan Patent Office, the contents and disclosure of which are hereby incorporated by reference herein in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

Example embodiments of the present patent application relate to an image forming apparatus such as a copier, facsimile machine, printer, plotter, and multiple function machine including two or more functions of these apparatuses and devices that form images on both sides of a recording medium.

2. Discussion of the Related Art

Electrophotographic image forming apparatuses generally include a fixing unit that employs a heat fixing system for fixing a toner image formed on a recording medium to the recording medium by application of heat and pressure. During a fixing process performed by the heat fixing system, moisture contained in the recording medium evaporates therefrom, which builds up condensation in the electrophotographic image forming apparatus.

Several techniques have been proposed to reduce or eliminate the accumulation of condensation in the image forming apparatus.

For example, in some related-art image forming apparatuses, if a fixing unit, which fixes an image to a transfer sheet serving as a recording medium by application of heat and pressure, starts to fix the image when the temperature in the related-art image forming apparatus is relatively low, moisture in the transfer sheet evaporates and builds up as condensation on transfer sheet guide plates that form sheet conveyance paths of the image forming apparatus.

Such a sheet conveyance path is generally provided to an image forming apparatus for a transfer sheet to pass through when printing an image on a single side or both sides of the transfer sheet. The sheet conveyance path has a relatively small amount of water because the transfer sheet is heated in the fixing unit and therefore a temperature of the transfer sheet guide plate is increased, and the transfer sheet passing through the sheet transfer conveyance path draws moisture from the image forming apparatus.

Further, some related-art image forming apparatuses include an outer cover that has a guide member for forming the fixing unit and a transfer sheet reverse path, and a hollow portion that is formed between the guide member and the outer cover in order to further reduce the creation of water droplets and prevent condensation in the image forming apparatus.

However, these approaches require additional components and add to the overall size of the apparatus, which is undesirable in the face of continued market demand for compact and inexpensive configurations.

Further, as the number of operations for allowing passage of transfer sheets such as single-side printing is increased, the transfer sheet reverse path formed of guide members can receive more water droplets adhered thereto. When printing

both sides of a transfer sheet after completion of a large amount of single-side printing, water droplets accumulated on the transfer sheet reverse path can adhere to the transfer sheet. This action can cause transfer failure at a transfer part such as a secondary transfer roller while forming an image, and produce defective images as a result.

Specifically, a compact image forming apparatus having a sheet conveyance path extending in a vertical direction generally includes a transfer sheet reverse path with a branched section for printing both sides of a transfer sheet after fixing the first side thereof. This configuration can build up condensation more easily.

Condensation is most likely to accumulate immediately after fixing. To eliminate water droplets or liquid droplets, holes or slots are formed on a transfer surface of each guide to reduce an area to which water droplets adhere. However, water droplets can still adhere to the transfer sheet guide plates of the sheet reverse path while printing the first side of a transfer sheet. Similarly, a duct member or other element or component to reduce or eliminate water droplets or condensation cannot be provided to prevent adhesion of water droplets to the transfer sheet guide plates because space for such an additional component is limited and cost can increase due to an increasing number of mechanical parts.

In other related-art image forming apparatuses having a hollow portion provided for eliminating condensation, the configuration can be simple and low-cost because no additional unit or device to avoid water droplets is provided thereto. However, when a hollow portion is located above the transfer sheet reverse path, water vapor produced in the fixing unit can travel via the transfer sheet reverse path to the hollow portion, and therefore water vapor can build up and condense on the transfer sheet guide plates that form the transfer sheet reverse path before it reaches the hollow portion to accumulate as water droplets for condensation. The accumulated water droplets can adhere to the transfer sheet to cause transfer failure at the transfer section when printing both sides of a next transfer sheet, which can produce defective images.

SUMMARY OF THE INVENTION

Example aspects of the present patent application have been made in view of the above-described circumstances.

Example aspects of the present patent application provide an image forming apparatus that has a compact body and a less expensive configuration and can eliminate water droplets without providing any additional unit and prevent a production of defective images due to water droplets from condensation of vapor even immediately after printing a large amount of single-side copies.

In one exemplary embodiment, an image forming apparatus includes a transfer unit, a fixing unit, a discharging unit, and multiple guide members. The transfer unit transfers an image onto a transfer sheet. The fixing unit is disposed downstream from the transfer unit in a direction of conveyance of the transfer sheet. The fixing unit fixes the image to the transfer sheet by application of heat and conveys the fixed transfer sheet to a further downstream portion of the image forming apparatus. The discharging unit is disposed downstream from the fixing unit in the direction of conveyance of the transfer sheet. The discharging unit discharges the transfer sheet to an external portion of the image forming apparatus. The multiple guide members are disposed above the fixing unit to form a sheet conveyance path. The sheet conveyance path includes a first path through which the transfer sheet is conveyed toward the discharging unit and a second path through which the transfer sheet from the first path is con-

veyed to receive another image on the other side thereof. Both the first path and the second path of the sheet conveyance path include a hollow portion defined by the multiple guide members to enable an air current generated during image forming to pass therethrough.

The air current may include vapor generated in a heated area of the fixing unit.

The hollow portion may extend to enable the air current to flow therein in a direction substantially perpendicular to the direction of conveyance of the transfer sheet.

The above-described image forming apparatus may further include a side cover having electrical components mounted thereon. The air current that includes the vapor may flow in a direction opposite the side cover having the electrical components mounted thereon.

The above-described image forming apparatus may further include side covers disposed extending in a direction intersecting a longitudinal axis of the fixing unit at both ends of the fixing unit. Each of the side covers may have multiple openings therein. The air current may be generated by passing through the multiple openings of the side covers.

The above-described image forming apparatus may further includes side covers disposed extending in a direction intersecting a longitudinal axis of the fixing unit at both ends of the fixing unit. Each of the side covers may have multiple openings therein. The air current may be generated by a forcedly generated flow of air substantially parallel to the longitudinal axis of the fixing unit.

At least one of the multiple guide members may include a moisture absorbing material to absorb and store liquid droplets from condensation of vapor generated in the fixing unit within the hollow portion.

One of the multiple guide members facing the hollow portion may include a collecting portion to collect and store liquid droplets from condensation of vapor generated in the fixing unit and another one of the multiple guide members facing the hollow portion may include a liquid guide member to guide the liquid droplets to the collecting portion.

The collecting portion of the liquid droplets may be included in the fixing unit.

The multiple guide members may form a wind tunnel to allow the air current to pass through the hollow portion in the fixing unit.

The air current may cool down the hollow portion surrounded by the multiple guide members.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the disclosure and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1** is a perspective view of an image forming apparatus according to example embodiments of the present patent application;

FIG. **2** is a longitudinal sectional view illustrating a schematic configuration of the image forming apparatus of FIG. **1**;

FIG. **3** is a cross-sectional view of the image forming apparatus of FIG. **1**, partially around the fixing unit and sheet conveyance paths;

FIG. **4** is a perspective view of the image forming apparatus of FIG. **1** for explaining details of example embodiments;

FIG. **5** is a front view of the image forming apparatus of FIG. **1**, showing an example of a front cover that is openable and closeable with respect to a main body of the image forming apparatus of FIG. **1**;

FIG. **6** is a front view of the image forming apparatus of FIG. **1**, showing an example that the front cover is detachable from the main body;

FIG. **7**A is a cross-sectional view of the image forming apparatus according to Example 1 and Modified Example 2 of the present patent application;

FIG. **7**B is a cross-sectional view of an upper fixing guide plate in the image forming apparatus according to Modified Example 3 of the present patent application;

FIG. **8** is a perspective view of the image forming apparatus according to Example Embodiment 2 of the present patent application, viewed from an upper right position;

FIG. **9**A is a cross-sectional view of the upper fixing guide plate of a fixing unit according to Modified Example 2 of the present patent application;

FIG. **9**B is a cross-sectional view of an outlet fixing guide plate of the fixing unit according to Modified Example 2 of the present patent application;

FIG. **9**C is a perspective view of the upper fixing guide plate of the fixing unit according to Modified Example 2 of the present patent application;

FIG. **9**D is a perspective view of a collecting portion of the fixing unit according to Modified Example 2 of the present patent application;

FIG. **10**A is a cross-sectional view of an upper fixing guide plate of a fixing unit according to Modified Example 3 of the present patent application;

FIG. **10**B is a cross-sectional view of an outlet fixing guide plate of the fixing unit according to Modified Example 3 of the present patent application;

FIG. **10**C is a cross sectional view of the upper fixing guide plate, the outlet fixing guide plate, and the collecting portion of the fixing unit according to Modified Example 3 of the present patent application;

FIG. **10**D is a perspective view of the outlet fixing guide plate of the fixing unit according to Modified Example 3 of the present patent application;

FIG. **10**E is an enlarged perspective view of the upper fixing guide plate of the fixing unit according to Modified Example 3 of the present patent application; and

FIG. **11** is a perspective view of an exit guide plate of a fixing unit according to Modified Example 4 of the present patent application.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It will be understood that if an element or layer is referred to as being "on", "against", "connected to" or "coupled to" another element or layer, then it can be directly on, against, connected or coupled to the other element or layer, or intervening elements or layers may be present. In contrast, if an element is referred to as being "directly on", "directly connected to" or "directly coupled to" another element or layer, then there are no intervening elements or layers present. Like numbers referred to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

Spatially relative terms, such as "beneath", "below", "lower", "above", "upper" and the like may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements describes as "below" or

"beneath" other elements or features would then be oriented "above" the other elements or features. Thus, term such as "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors herein interpreted accordingly.

Although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers and/or sections, it should be understood that these elements, components, regions, layer and/or sections should not be limited by these terms. These terms are used only to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present patent application. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes" and/or "including", when used in this specification, specify the presence of started features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

In describing example embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent application is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that operate in a similar manner.

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, example embodiments of the present patent application are described.

Now, example embodiments of the present patent application are described in detail below with reference to the accompanying drawings.

Descriptions are given, with reference to the accompanying drawings, of examples, example embodiments, modification of example embodiments, etc., of an image forming apparatus according to the present patent application. Elements having the same functions and shapes are denoted by the same reference numerals throughout the specification and redundant descriptions are omitted. Elements that do not require descriptions may be omitted from the drawings as a matter of convenience. Reference numerals of elements extracted from the patent publications are in parentheses so as to be distinguished from those of example embodiments of the present patent application.

The present patent application includes a technique applicable to any image forming apparatus. For example, the technique of the present patent application is implemented in the most effective manner in an electrophotographic image forming apparatus.

Exemplary Embodiment 1

Referring to FIGS. **1** through **3**, descriptions are given of a schematic configuration and operations of an image forming apparatus **100** according to Example Embodiment 1 of the present patent application.

FIG. **1** illustrates a perspective view of the image forming apparatus **100**, and FIG. **2** illustrates a vertical cross-section of an interior of the image forming apparatus **100** of FIG. **1**.

The image forming apparatus **100** can be any of a copier, a printer, a facsimile machine, a plotter, and a multifunction printer including at least one of copying, printing, scanning, plotter, and facsimile functions. In this non-limiting exemplary embodiment, the image forming apparatus **100** functions as a full-color printing machine for electrophotographically forming a toner image based on image data on a recording medium (e.g., a transfer sheet).

The toner image is formed with four single toner colors, which are yellow, cyan, magenta, and black. Reference symbols "Y", "C", "M", and "K" represent yellow color, cyan color, magenta color, and black color, respectively.

The image forming apparatus **100** shown in FIGS. **1** and **2** includes a main body **1**, an image forming part **2**, a sheet feeding part **20**, a sheet discharging part **25**, a sheet stacking part **40**.

The image forming part **2** is located at a substantially center part of the main body **1** of the image forming apparatus **100** to form one or more images on a transfer sheet.

The sheet feeding part **20** is disposed below the image forming part **2** to feed and convey a recording medium such as a transfer sheet S or other sheet-like recording medium.

After image forming part **2** form the image on the transfer sheet, the sheet discharging part **25** discharges the transfer sheet S in a direction from the near side or front side of the main body **1** of the image forming apparatus **100**, which is the right-hand side on FIG. **2**, to the far side or rear side of the main body **1** of the image forming apparatus **100**, which is the left-hand side on FIG. **2**.

The sheet stacking part **40** is disposed above the image forming part **2** to stack the transfer sheets that are discharged from the sheet discharging part **25** in a direction (Xa) of discharging a transfer sheet S, which is described below.

The transfer sheet that serves as a recording medium includes a sheet-like recording medium (e.g., thick paper, postcard, envelope, regular paper, and thin paper), a coated paper (e.g., art paper), OHP sheet or OHP film, and a tracing paper, and indicates a transferable image forming material.

The image forming apparatus **100** shown in FIGS. **1** and **2** corresponds to a tandem-type color image forming apparatus. In FIG. **1**, "Xa" represents a direction of discharging a transfer sheet, "Xb" represents a direction opposite the direction Xa, and "Y" represents a sheet widthwise direction perpendicular to the sheet discharge direction Xa.

The image forming part **2** is also referred to as an "image recording part **2**" that forms an image as a record on the transfer sheet S.

The sheet stacking part **40** is also referred to as a sheet accumulation part **40** to accommodate the output sheet therein.

As shown in FIG. **2**, the image forming part **2** includes drum-shaped photoconductors **3***a*, **3***b*, **3***c*, and **3***d*, each of which serves as an image carrier. The photoconductors **3***a*, **3***b*, **3***c*, and **3***d* form respective toner images with corresponding toners of different colors. Specifically, the photoconductors **3***a*, **3***b*, **3***c*, and **3***d* shown in FIG. **2** form a yellow toner image, a cyan toner image, a magenta toner image, and a black toner image, respectively, on each surface thereof. The photoconductors **3***a*, **3***b*, **3***c*, and **3***d* are disposed at given intervals and substantially parallel to each other.

The intermediate transfer belt **4** that serves as a transfer unit is disposed below and facing the photoconductors **3***a*, **3***b*, **3***c*, and **3***d*. The intermediate transfer belt **4** shown in FIG. **2** is spanned around and extended by multiple support rollers **5**

and **6** and rotates in a direction indicated by arrow in FIG. **2** or in a counterclockwise direction in FIG. **2**.

Although the intermediate transfer member illustrated herein is a belt-shaped member, example embodiments of the present patent application are not intended to be limited to this configuration. For example, the intermediate transfer member of the present patent application may be a drum-shaped member.

Since units and components around each of the photoconductors **3***a*, **3***b*, **3***c*, and **3***d* have similar structures and functions, except that respective toners are of different colors, which are yellow, cyan, magenta, and black toners, the descriptions below will be applied to any of the photoconductors **3***a*, **3***b*, **3***c*, and **3***d* when the units and components are described without suffixes. Further, the discussion below occasionally uses reference numerals without suffixes "a", "b", "c", and "d" for specifying components of the image forming apparatus **100**.

The photoconductor **3***a* is surrounded by image forming units and components, specifically a charging unit **7**, a light scanning unit or LSU **8**, a developing unit **9**, a primary transfer member **10**, and a cleaning unit **11**.

The charging unit **7** uniformly charges the surface of the photoconductor **3***a*.

The LSU **8** serves as an optical writing unit to emit a laser light beam to expose or irradiate the surface of the photoconductor **3** according to image data so that an electrostatic latent image is formed on the surface of the photoconductor **3**.

The developing unit **9** develops the electrostatic latent image formed on the surface of the photoconductor **3** into a visible toner image.

The primary transfer member **10** is disposed facing the photoconductor **3** via the intermediate transfer belt **4**.

The cleaning unit **11** cleans the photoconductor **3** by removing residual toner remaining on the surface of the photoconductor **3** after the transfer of the image onto the intermediate transfer belt **4**.

The charging unit **7**, the LSU **8**, the developing unit **9**, the primary transfer member **10**, and the cleaning unit **11** are disposed around the photoconductor **3** in this order.

When the image forming apparatus **100** starts an image forming operation, the photoconductor **3***a* rotates in a clockwise direction of FIG. **2**. At this time, the charging unit **7** uniformly charges the surface of the photoconductor **3***a* to a give polarity. The LSU **8** then emits the laser light beam according to the image data to irradiate the surface of the photoconductor **3***a*, thereby forming an electrostatic latent image thereon. The developing unit **9** develops the electrostatic latent image into a yellow toner image. Then, the primary transfer member **10** transfers the yellow toner image onto a surface of the intermediate transfer belt **4**.

The same image forming operation is performed with respect to the photoconductors **3***b*, **3***c*, and **3***d*. Accordingly, the yellow toner image, the cyan toner image, the magenta toner image, and the black toner image that are formed on the photoconductors **3***a*, **3***b*, **3***c*, and **3***d*, respectively, are sequentially overlaid on the surface of the intermediate transfer belt **4**, thereby forming an overlaid four-color toner image is formed.

The image forming apparatus **100** further includes a secondary transfer roller **12** that is disposed facing the support roller **6** via the intermediate transfer belt **4**.

The sheet feeding part **20** is disposed below the image forming part **2** and includes a sheet feed tray **21**, a sheet feed roller **22**, a friction pad **23**, and a sheet reverse path **24**.

The sheet feed tray **21** serves as a sheet container to accommodate a transfer sheet S of multiple transfer sheets serving as recording media. The transfer sheet S corresponds to a transfer paper, recording paper, resin film, or the like.

The sheet feed roller **22** feeds the transfer sheet S accommodated in the sheet feed tray **21**.

The friction pad **23** serves as a sheet separation unit to separate multi-fed sheets one by one.

The sheet reverse path **24** is formed to convey the transfer sheet S therethrough when performing duplex printing or forming images on both sides of the transfer sheet S.

The transfer sheet S fed from the sheet feeding part **20** is conveyed to a pair of registration rollers **13** until the leading edge thereof contacts against the pair of registration rollers **13**. By stopping at the pair of registration rollers **13**, skew or misalignment of the leading edge of the transfer sheet S is corrected and adjusted, if any. Then, the pair of registration rollers **13** starts its rotation again to feed the leading edge of the transfer sheet S in synchronization with movement of the intermediate transfer belt **4** so that the four-color toner image formed on the intermediate transfer belt **4** can be timely transferred onto the transfer sheet S at a secondary transfer nip portion formed between the secondary transfer roller **12** and the support roller **6**.

After receiving the four-color toner image at the secondary transfer nip portion, the transfer sheet S is conveyed to the fixing unit **14**.

The fixing unit **14** includes a fixing roller **14***a*, a pressure roller **14***b*, and a fixing belt **14***c*. The fixing belt **14***c* is spanned around the fixing roller **14***a*, and the pressure roller **14***b* presses against the fixing roller **14***a* via the fixing belt **14***c*. The fixing unit **14** fixes the four-color toner image to the transfer sheet S by application of heat and pressure.

Although the fixing unit **14** illustrated herein generally has the above-described configuration, example embodiments of the present patent application are not intended to be limited to this configuration. For example, the fixing unit of the present patent application may be a roller type including a heater therein, a heating method using an induction heater, etc.

The fixed transfer sheet S is then conveyed by a pair of sheet discharging rollers **25***a* and **25***b* of a sheet discharging part **25** and discharged to the sheet stacking part **40** in a face-down manner. The sheet stacking part **40** is formed on top of the main body **1** of the image forming apparatus **100**.

Residual toner or foreign materials remaining on the surface of the intermediate transfer belt **4** after transfer are removed by a belt cleaning unit **15** so as to be ready for subsequent image forming operations.

Referring to FIGS. **2** and **3**, descriptions are given of a configuration around a sheet discharging part **25** and a sheet reverse path **30**.

FIG. **3** is a cross-sectional view of the image forming apparatus **100**, partially around the sheet discharging part **25** and the sheet reverse path **30** of the fixing unit **14**.

A separation claw **31** is disposed in the vicinity of the sheet discharging roller **25***a*. The separation claw **31** serving as a switching guide member is rotatable about a shaft thereof to switch a direction of conveyance of the transfer sheet S that has an image formed on one side either to the sheet discharging part **25** or to the sheet reverse path **30**. When the separation claw **31** is at a position indicated by a solid line, it guides the fixed transfer sheet S to the sheet discharging part **25** so that the transfer sheet S can be conveyed by the pair of sheet discharging rollers **25***a* and **25***b* to be discharged to a sheet stacking tray **41** of the sheet stacking part **40**.

The image forming apparatus **100** shown in FIG. **1** includes various paths and rollers for reversing and re-feeding the transfer sheet S so that images can be formed on the both sides of the transfer sheet S automatically. Specifically, the image

forming apparatus **100** further includes a switchback path **33** above the sheet discharging part **25**.

The transfer sheet S fed by the sheet feeding part **20** passes through the secondary transfer nip portion of the secondary transfer roller **12** and the fixing unit **14**, where an image is formed on the one side of the transfer sheet S. At this time, the separation claw **31** rotates in a clockwise direction in FIG. **1** so that the transfer sheet S with the image on one side thereof is guided over an upper face of the separation claw **31** to an upper portion of the sheet discharging roller **25***a* to change the direction of conveyance of the transfer sheet S to be reversed. As the sheet discharging roller **25***a* rotates in a counterclockwise direction, the transfer sheet S is conveyed to a downstream side of the switchback path **33**, which is in a direction toward the sheet stacking tray **41**.

When the trailing edge of the transfer sheet S passes the free end of the separation claw **31**, the sheet discharging roller **25***a* stops and rotates in a clockwise direction to convey the transfer sheet S to the sheet reverse path **30**, as indicated by arrow A shown in FIG. **3**.

As shown in FIG. **2**, transfer rollers **32***a* and **32***b* that can rotate in both directions are disposed in contact with each other in the sheet reverse path **30**. When the transfer sheet S is conveyed in the sheet reverse path **30**, the transfer rollers **32***a* and **32***b* hold the transfer sheet S therebetween so as to guide the transfer sheet S to be fed via the reverse sheet conveyance path **24** to the pair of registration rollers **13**.

As previously described, the transfer rollers **32***a* and **32***b* are in contact with each other. Therefore, when the transfer roller **32***a* rotates in a counterclockwise direction in FIG. **2**, the transfer roller **32***b* is rotated with the transfer roller **32***a* to guide and feed the transfer sheet S that is conveyed through the sheet reverse path **30** toward the pair of registration rollers **13**.

Next, a description is given of detailed image forming operations of the duplex printing with the above-described configuration.

After a first image is transferred from the intermediate transfer belt **4** onto a front side or first side of the transfer sheet S, the transfer sheet S is conveyed through a general sheet conveyance path **35** that is indicated by arrow B as shown in FIG. **3**. After the fixing operation is conducted in the fixing unit **14**, the transfer sheet S is guided by the separation claw **31** that is rotated in a clockwise direction as indicated by the solid line shown in FIG. **3** to the switchback path **33**. As the sheet discharging roller **25***a*, which serves as a drive roller, rotates in a counterclockwise direction, the transfer sheet S is conveyed toward the sheet stacking tray **41**. Then, after the trail edge of the transfer sheet S has passed the free end of the separation claw **31**, the sheet discharging roller **25***a* rotates in a counterclockwise direction. With the change of the direction of rotation of the sheet discharging roller **25***a*, the trailing edge of the transfer sheet S becomes the leading edge thereof so that the transfer sheet S is conveyed toward the transfer rollers **32***a* and **32***b* in the sheet reverse path **30** in the direction as indicated by arrow A in FIG. **3**. When the transfer sheet S reaches the pair of registration rollers **13**, the pair of registration rollers **13** stops while holding the transfer sheet S therebetween. The pair of registration rollers **13** starts rotating again in synchronization with movement of the intermediate transfer belt **4** to convey the transfer sheet S to the secondary transfer nip portion to form a toner image formed on the intermediate transfer belt **4** onto a back side or second side of the transfer sheet S.

The image to be formed on the second side of the transfer sheet S is formed with the above-described image forming processes as the transfer sheet S travels. That is, the image for the second side of the transfer sheet S is formed with the similar processes to those for forming the full-color toner image on the first side thereof, and the full-color toner image is conveyed by the intermediate transfer belt **4**. Except, this time the leading edge of the transfer sheet S is reversed to act as the trailing edge thereof in the sheet reverse path **30**. Therefore, the image forming apparatus **100** causes the LSU **8** to emit the laser light beams according to image data output from the opposite side in the direction of conveyance of the transfer sheet S such that the image for the second side of the transfer sheet S can be formed correctly in the same direction of the image on the first side thereof.

Thus, the transfer sheet S having toner images on both sides passes through the general sheet conveyance path **35** indicated by arrow B shown in FIG. **3** for fixing the new image to the second side of the transfer sheet S in the fixing unit **14**, and is discharged by the pair of sheet discharging rollers **25***a* and **25***b* to the sheet stacking tray **41**. To form images on both sides of the transfer sheet S more efficiently, a control unit, not shown, of the image forming apparatus **100** controls times of forming images on the first and second sides of the transfer sheet S.

In FIGS. **1** and **2**, the image forming apparatus **100** further includes a control panel **16**. The control panel **16** controls operations performed by the image forming part **2**. The control panel **16** is placed on a front side of the main body **1** of the image forming apparatus **100**. That is, the sheet discharging part **25** of the image forming apparatus **100** is disposed near the front side of the main body **1**, and a sheet (e.g., the transfer sheet S) is discharged to the sheet stacking part **40** from the near side to the far side of the image forming apparatus **100**.

The image forming apparatus **100** further includes an upper cover **18**. The upper cover **18** is a cover member to cover the image forming part **2** and is disposed on top of the main body **1**. A top surface of the upper cover **18** includes or is used as the sheet stacking tray **41** that serves as a sheet stacking table of the sheet stacking part **40**. The upper cover **18** has no bank or sheet stopping member at the far end. With this configuration, even if a sheet with its length longer than the sheet stacking tray **41** of the upper cover **18** is conveyed, the leading part of the sheet may not be stopped by the bank and can go over it. Therefore, the long sheet can be stacked thereon without any problem.

As shown in FIG. **2**, the upper cover **18** supports the LSU **8** that is disposed below there and included in the image forming part **2**. The upper cover **18** rotates upward about a hinge **17** disposed at the far side of the image forming apparatus **100**.

A locking lever **60** is disposed to serve as a locking member and locks the upper cover **18** to the main body **1** of the image forming apparatus **100**. When the locking lever **60** unlocks the upper cover **18**, the upper cover **18** can rotate about the hinge **17**.

When the upper cover **18** is rotated in a counterclockwise direction to open, the LSU **8** is rotatably moved upward with the upper cover **18**. This action enables a service representative to access units and components of the image forming part **2**, thereby easily performing maintenance.

Further, while the upper cover **18** is open, four process cartridges can be detached from or attached to the image forming apparatus **100**. Each of the process cartridges integrally includes the photoconductor **3** and image forming units and components (e.g., the charging unit **7**, the developing unit **9**, and the cleaning unit **11**) disposed around the photoconductor **3**.

When the upper cover **18** rotates to open, the near side of the sheet stacking tray **41** moves upward and the far side

thereof can be positioned lower than the near side thereof. However, if the upper cover **18** rotates upward by mistake when the transfer sheets S are stacked on the sheet stacking tray **41**, the transfer sheets S stacked on the sheet stacking tray **41** can fall or slide downward to the far side of the image forming apparatus **100**. That is, if a user leaves the stack of the transfer sheet S on the sheet stacking tray **41** and opens the upper cover **18**, the transfer sheets S on the sheet stacking tray **41** can fall to the back side of the main body **1** of the image forming apparatus **100**. This problem can be solved by providing a bank or sheet stopping member at the far side of the upper cover **18**. However, a long sheet can abut against such a bank or sheet stopping member when discharging the long sheet, which can cause a problem to the condition of the sheet stack.

To eliminate the above-described problem, the image forming apparatus **100** according to an example embodiment of the present patent application includes a handle **61** that is positioned on the sheet stacking tray **41** and arranged to be hidden or covered by the stacked transfer sheet S. The handle **61** is used to unlock the locking lever **60** and cause the upper cover **18** to rotate to open.

The locking lever **60** integrally includes the handle **61** at one end thereof for user to operate it and a lock claw **62** at the other end thereof. The lock claw **62** engages with a projection part **64** that is fixedly mounted on the main body **1** of the image forming apparatus **100**. The locking lever **60** is rotatable about a pin **63** that is fixedly mounted to the upper cover **18**. A screw coil spring, not shown, is attached around the pin **63**, and applies, to the lock lever **60**, a force exerted in a direction to which the lock claw **62** is constantly engaged with the projection part **64**. The handle **61** is formed by a flat material and the surface thereof extends along the surface of the sheet stacking tray **41**. The sheet stacking tray **41** includes a concave part **44** that spreads out in a fan-like form, as shown in FIG. **1**, in order for a user to hold the handle **61** easily.

As described above, to open the upper cover **18**, a user slidingly puts his/her hand to the concave part **44** to hold the handle **61** and lifts the handle **61** of the locking lever **60** upward against the force exerted by the screw coil spring. With this operation, the locking lever **60** rotates about the pin **63** and the lock claw **62** is disengaged with the projection part **64**. As the user continuously lifts the handle **61**, the upper cover **18** is rotated about the hinge **17**.

As described above, the handle **61** of the locking lever **60** is located on the sheet stacking tray **41**, thereby surely preventing undesirable rotation and opening of the upper cover **18** while the transfer sheet S is placed on the sheet stacking tray **41**.

Referring to FIGS. **4** through **6**, descriptions are given of the detailed configuration of the image forming apparatus **100**.

FIG. **4** is a perspective view of the image forming apparatus **100** for explaining details of the configuration. FIG. **5** is a front view of the image forming apparatus **100**, showing an example of a front cover **27** that is openable and closeable with respect to the main body **1** of the image forming apparatus **100**. FIG. **6** is a front view of the image forming apparatus **100**, showing an example that the front cover **27** is detachable from the main body **1**.

As shown in FIG. **5**, the front cover **27** of the main body **1** rotates about a hinge **28** to open toward a user (to the right-hand side in FIG. **5**) so as to show the inside of the main body of the image forming apparatus **100**. That is, by opening the front cover **27**, replacement and/or maintenance for the intermediate transfer belt **4** and related units or components, a waste toner bottle **65**, and the fixing unit **14** and removal of paper(s) jammed in the sheet conveyance path of the main body **1** (see FIG. **4**).

Further, as shown in FIG. **6**, the main body **1** includes an opening **29** in the front cover **27** to insert the sheet feed tray **21** thereto. With this configuration, the sheet feed tray **21** can be attached to and detached from the main body **1** through the opening **29** from the front side of the image forming apparatus **100**, which is in a horizontal direction, left to right and right to left in FIG. **6**. FIG. **6** shows that the sheet feed tray **21**, the friction pad **23**, and the sheet reverse path **24** are pulled together and detached at once from the main body **1** to a direction indicated by arrow P in FIG. **6**. By so doing, user and/or service representative can conduct manned operations such as machine maintenance, replacement of consumables, and removable of jammed paper(s) fully from the front side of the main body **1** of the image forming apparatus **100**. Accordingly, additional space may not be needed at the back side of the image forming apparatus **100** to perform the above-described manned operations and an installation area can be reduced in size, thereby providing an easily operable, user friendly, and low-cost image forming apparatus.

Next, detailed descriptions are given of the fixing unit **14**, the sheet conveyance paths **30** and **35**, and units and components disposed therearound, in reference to FIGS. **3** and **4**.

In FIG. **3**, the image forming apparatus **100** shown in FIG. **3** further includes an upper fixing guide plate **70**, an outlet fixing guide plate **71**, and a lower fixing guide plate **75**.

The upper fixing guide plate **70** serves as a guide member to form the sheet reverse conveyance path **30**.

The outlet fixing guide plate **71** is disposed in the vicinity of an exit of the fixing unit **14** and serves as a guide member to form the general sheet conveyance path **35**.

The lower fixing guide plate **75** is disposed below the sheet discharging roller **25***b* and serves as a guide member to form the general sheet conveyance path **35**.

The "guide member" explained herein has a generic meaning to indicate an original guide member for guiding a paper to a direction it should be conveyed, a member that is connected to the original guide member, and a guide rib that is integrally mounted to the original guide member, etc.

As shown in FIG. **4**, the image forming apparatus **100** further includes an external left cover **1***a*, an external right cover **1***b*, a left frame **55**, a right frame **56**, and a louver **77**.

The louver **77** includes multiple openings and/or slots formed on each of the external left cover **1***a* and the external right cover **1***b*.

Further, electrical components are positioned between the left external cover **1***a* that corresponds to a side cover of the main body **1** and the left frame **55**, when viewed from the front side of the main body **1**.

Further, a direction Xc indicates a direction of conveyance of the transfer sheet S, which corresponds to a vertical direction.

In FIGS. **3** and **4**, the front cover **27** (see FIGS. **1** through **4**) integrally mounting a guide plate, not shown, that forms the sheet reverse conveyance path **30** is disposed to face the upper fixing guide plate **70**.

Further, in FIG. **3**, the upper fixing guide plate **70** and the outlet fixing guide plate **71** forms a guide plate unit that is freely openable and closeable about a fulcrum, not shown, disposed an upper left end portion thereof in FIG. **3**. By opening the guide plate unit, a user and/or service representative can enhance the operability during maintenance for the fixing unit **14** and jammed paper removal. This effect can be applied to the configurations shown in FIGS. **7** and **8**, which will be described below.

Example Embodiment 1

Referring to FIG. **7**A, a description is given of the image forming apparatus **100** according to Example Embodiment 1 of the present patent application.

In FIG. **7**A illustrating the configuration according to Example Embodiment 1, the image forming apparatus **100** includes hollow portions **67** and **69**.

The hollow portion **67** is located above the fixing unit **14**, between the fixing unit **14** and the sheet reverse path **30**. The hollow portion **67** is surrounded by the upper fixing guide plate **70** and the outlet fixing guide plate **71**. Both of the upper fixing guide plate **70** and the outlet fixing guide plate **71** serve as multiple guide members.

The hollow portion **69** is surrounded by the lower fixing guide plate **75**. The lower fixing guide plate **75** is also included in the multiple guide members.

An air current that may include vapor is generated in a heated area of the fixing unit **14** during image forming and flows to the hollow portions **67** and **69** or to inner walls of the upper fixing guide plate **70** and the outlet fixing guide plate **71**. The multiple guide members including the upper fixing guide plate **70** and the outlet fixing guide plate **71** form a wind tunnel in the image forming apparatus **100**.

In FIG. **7**A, the air current with vapor indicated by arrow A travels upward from the fixing unit **14** and is collected to the hollow portion **67** formed and defined by the upper fixing guide plate **70** and the outlet fixing guide plate **71**. The upper part of the hollow portion **67** is formed in a wall shape to control the vapor rising from the air current A for effectively collecting the uprising vapor and is formed by two types of guide plates as described above, so that the hollow portion **67** can be sealed more tightly.

Further, the hollow portion **69** can have the similar configuration to the hollow portion **67**, except that the hollow portion **69** is formed and defined by the lower fixing guide plate **75**, as shown in FIG. **7**A.

Example Embodiment 2

Referring to FIG. **8**, a description is given of the image forming apparatus **100** according to Example Embodiment 2 of the present patent application.

As shown in FIG. **8**, the hollow portion **67** extends to enable an air current indicated by arrow B to flows in the hollow portion **67** in a direction substantially perpendicular to the direction Xc that is a direction of conveyance of the transfer sheet S. That is, the air current B travels in the hollow portion **67**.

As previously shown in FIG. **4**, the louver **77** is formed on each of the left external cover **1***a* of the left frame **55** and the right external cover **1***b* of the right frame **56**. Since the temperature in the vicinity of the right side and the temperature in the vicinity of the left side in the main body **1** of the image forming apparatus **100** can be different due to design for air current control in the main body **1**. For example, the temperature in the left side of the main body **1** of the image forming apparatus **100** is set to be higher than the temperature in the right side. By so doing, an air current is generated due to a temperature difference in the hollow portion **67**.

The air current B that flows in the substantially perpendicular to the direction Xc can be generated either when passing the air taken from the louver **77** through the hollow portion **67** or when forcedly generating the air current B flowing substantially parallel to the longitudinal axis of the fixing unit **14** or in a direction perpendicular to the direction Xc by using, for example, an axial flow fan provided to the image forming apparatus **100**.

According to the air current B that flows in a direction perpendicular to the direction Xc, the air current A, which flows from the fixing unit **14** to the hollow portion **67** and is collected to the upper portion of the hollow portion **67**, can be further attracted to the hollow portion **67**, be increased in the speed of flow of the air current A, and can increase an effect of attraction of vapor to the hollow portion **67**.

As described above, the image forming apparatus **100** includes the configuration in which the air current can be generated by receiving air passing through the louver **77** of the left external cover **1***a* or by intaking outside air using the axial flow fan and by exiting the air through the louver **77** of the right external cover **1***b*. With this configuration, fresh external air are taken in so that the fresh external air can cool down the hollow portion **67** to condense the vapor collected in the hollow portion **67** into water droplets or liquid droplets.

The outlet fixing guide plate **71** has two outer faces, which are a first outer face and a second outer face. The first outer face of the outlet fixing guide plate **71** forms the general sheet conveyance path **35** along which the transfer sheet S is conveyed. The first outer face thereof is not affected by fresh air and is heated by the fixing unit **14** of the main body **1** of the image forming apparatus **100**. Therefore, the first outer face of the outlet fixing guide plate **71** has a high temperature and water droplets are not adhered to the transfer sheet S and the outlet fixing guide plate **71**. The second outer face of the outlet fixing guide plate **71** defines or sections the hollow portion **67**, however does not form the general sheet conveyance path **35**.

By contrast, inner faces of the upper fixing guide plate **70** and the outlet fixing guide plate **71** along which the air current cooled by fresh air travels or facing the hollow portion **67** have a low temperature so that the cooled air can condenses into water droplets to adhere to the upper fixing guide plate **70** and the outlet fixing guide plate **71**. According to these effects, the above-described configuration can be achieved.

Here, the inner faces of the upper fixing guide plate **70** and the outlet fixing guide plate **71** correspond to faces opposite the outer faces of the upper fixing guide plate **70** and the outlet fixing guide plate **71** which form the general sheet conveyance path **35**. Specifically, the outlet fixing guide plate **71** has two inner faces, which are a first inner face and a second inner face. The first inner face of the outlet fixing guide plate **71** is formed on an opposite side of the first outer face thereof and defines or sections the hollow portion **67** while the second inner face is formed on an opposite side of the second outer face thereof and defines or sections the hollow portion **67**.

Further, by increasing a height of each rib of the upper fixing guide plate **70** and the outlet fixing guide plate **71**, the difference between temperatures of the upper fixing guide plate **70** and the outlet fixing guide plate **71** can be larger.

In FIG. **8**, the image forming apparatus **100** further includes a duplex guide member **37** and a sheet discharging guide member **74**.

The duplex guide member **37** is provided as a transfer guide of the sheet reverse path **30**.

The sheet discharging guide member **74** is provided as a transfer guide of the sheet discharging path **26**.

As shown in FIG. **4**, the image forming apparatus **100** further includes electrical components that are mounted together on a component assembly portion **78** located between the left frame **78** and the left external cover **1***a* so as to enhance the positional efficiency of electric components such as harness wiring. In the image forming apparatus **100**

shown in FIG. **4**, air currents C and D that include vapor also flow in the hollow portion **67** in a direction perpendicular to the direction Xc of conveyance of the transfer sheet S. The air currents C and D are controlled to flow in a direction opposite the component assembly portion **78**, thereby preventing failure due to adhesion of water droplets to the electrical components.

Modified Example 1

In addition to Example Embodiments 1 and 2, a different example, Modified Example 1, can be applied to the present patent application.

In Modified Example 1, a moisture absorbing material may be provided on the inner faces of the upper fixing guide plate **70** and the outlet fixing guide plate **71** that define the hollow portion **67** or in the hollow portion **67**. The moisture absorbing member absorbs and easily stores water droplets from condensation of vapor generated in the fixing unit **14** within the hollow portion **67**.

Modified Example 2

In addition to Example Embodiments 1 and 2 and Modified Example 1, yet another example, Modified Example 2, can be applied to the present patent application, in reference to FIG. **7**A, which is also used in Example Embodiment 1, and FIGS. **9**A through **9**D.

FIG. **9**A is a cross-sectional view of the upper fixing guide plate **70** of the fixing unit **14**, FIG. **9**B is a cross-sectional view of the outlet fixing guide plate **71** of the fixing unit **14**, FIG. **9**C is a perspective view of the upper fixing guide plate **70** of the fixing unit **14**, and FIG. **9**D is a perspective view of a liquid collector **72** of the fixing unit **14**.

As shown in FIGS. **7**A and **9**A through **9**D according to Modified Example 2, the image forming apparatus **100** further includes a guide rib **70***a* that serves as a liquid guide member. The guide rib **70***a* is flared or increases in thickness as it extends toward the liquid collector **72** and is disposed on the inner surface of the upper fixing guide plate **70** the defines the hollow portion **67**. With this configuration, water droplets **68** included in liquid droplets can be guided and conveyed to a target portion.

In Modified Example 2, the guide rib **70***a* guides the water droplets **68**, which are adhered to the inner face of the upper fixing guide plate **70**, to the liquid collector **72** so that the water droplets **68** can be stored and reserved therein. The liquid collector **72** serves as a collecting portion and is surrounded and defined by a guide rib **71***a* that is mounted on the first inner face of the outlet fixing guide plate **71** disposed below the upper fixing guide plate **70**.

Modified Example 3

In addition to Example Embodiments 1 and 2 and Modified Example 1, yet another example, Modified Example 3, can be applied to the present patent application, in reference to FIG. **7**B and FIGS. **10**A through **10**E.

FIG. **7**B illustrates the upper fixing guide plate **70** including ribs **70***b***1** through **70***b***5**, FIG. **10**A illustrates the upper fixing guide plate **70**, viewed from an angle different from FIG. **7**B, FIG. **10**B illustrates the outlet fixing guide plate **71** including the guide ribs **71***a*, FIG. **10**C illustrates the upper fixing guide plate **70** and the outlet fixing guide plate **71**, viewed from the external left cover **1***a* of the image forming apparatus **100**, FIG. **10**D illustrates the liquid collector **72** formed on the outlet fixing guide plate **71**, and FIG. **10**E is an enlarged perspective view of the upper fixing guide plate **70**.

As shown in FIGS. **7**B, **10**A, **10**C, and **10**D, the upper fixing guide plate **70** includes the ribs **70***b***1** through **70***b***5** that serve as liquid guide members. The ribs **70***b***1** through **70***b***5** are arranged along the direction Xc on the first inner face of the upper fixing guide plate **70** with different steps in height. That is, as shown in FIG. **10**A, the ribs **70***b***1** through **70***b***5** are formed gradually higher or longer than its left adjacent rib so that the heights of the ribs **70***b***1** through **70***b***5** can be greater along a direction to which the air current flows. Therefore, the rib **70***b***1** becomes shortest and the rib **70***b***5** becomes longest as a result.

Further, as shown in FIGS. **10**B, **10**C, and **10**D, the liquid collector **72** is formed and defined by the guide ribs **71***a* disposed on the inner face of the outlet fixing guide plate **71**.

With the above-described configuration, the water droplets **68** adhering to the ribs **70***b***1** to **70***b***5** are guided to fall onto the liquid collector **72**. With this action, the water droplets **68** can be conveyed to the outlet fixing guide plate **71** with high temperature due to being disposed in the vicinity of the heated area of the fixing unit **14**. Therefore, the water droplets **68** can be evaporated more effectively and more quickly.

Modified Example 4

In addition to Example Embodiments 1 and 2 and Modified Examples 1, 2, and 3, yet another example, Modified Example 4, can be applied to the present patent application, in reference to FIG. **11**.

FIG. **11** illustrates the output fixing guide plate **71** and the image forming components mounted on and disposed in the vicinity of the output fixing guide plate **71**. That is, the upper fixing guide plate **70** and the outlet fixing guide plate **71** form a wind tunnel between the hollow portion **67** and the fixing unit **14**.

As shown in FIG. **11** according to Modified Example 4, the outlet fixing guide plate **71** has multiple openings **71***b* formed thereon. With this configuration, the image forming apparatus **100** can intake the air current A easily from the multiple openings **71***b* to the hollow portion **67** disposed substantially directly above the fixing unit **14**. That is, the outlet fixing guide plate **71** can collect and store the water droplets **68**, increase the temperature or be heated in the vicinity of the heated area of the fixing unit **14**, and cause the air current to flow.

As described above, any of the configurations according to the above-described example embodiments and/or modified examples can perform the above-described operations and actions. Therefore, the present patent application can have the following effects.

By utilizing the hollow portion **67** defined by the multiple guide plates (e.g., the upper fixing guide plate **70**, the outlet fixing guide plate **71**, and the lower fixing guide plate **75**) to enable an air current to pass through the hollow portion during image forming, the water droplets or liquid droplets **68** from condensation of vapor generated in the fixing unit **14** can be collected to the hollow portion **67** without providing an additional unit to eliminate the water droplets **68**, thereby effectively preventing defective images.

By extending the hollow portion to enable the air current to follow therein in a direction substantially perpendicular to the direction of conveyance of the transfer sheet S, an amount of air current to collect the vapor generated after fixing, to the hollow portion **67**.

By cooling down the inner faces of the upper fixing guide plate **70** and the outlet fixing guide plate **71**, the water droplets

68 can adhere to the inner faces thereof defining the hollow portion 67 so as to avoid the water droplets 68 to the transfer sheet S, and a longitudinal or widthwise direction of the multiple guide members extending substantially perpendicular to the direction of conveyance of the transfer sheet S can be cooled so as to eliminate the water droplets 68 in the widthwise direction of the transfer sheet S.

By controlling the air current to flow in the direction opposite the side cover (e.g., the external left cover 1*a*) with the electrical components mounted thereon, the adhesion of water droplets 68 to the electrical components as well as the transfer sheet S can be prevented.

By providing a moisture absorbing material to absorb and store the water droplets 68 from condensation of vapor generated in the fixing unit 14 within the hollow portion 67, the water droplets 68 may not be conveyed to the sheet conveyance paths (e.g., the general sheet conveyance path 35 and the sheet reverse path 30) and/or the electrical components mounted on the external left cover 1*a*.

By providing the collecting portion (e.g., the liquid collector 74) and the liquid guide member (e.g., the guide rib 70*a* and the ribs 70*b*1 through 70*b*5), the water droplets 68 can be collected and stored outside the sheet conveyance paths and within the hollow portion 67, thereby preventing failures such as adhesion of water droplets 68 to the transfer sheet S.

By providing the collecting portion in the fixing unit 14, the water droplets 68 can be conveyed to the heated area of the fixing unit 14, thereby evaporating or eliminating the water droplets 68 more quickly.

By forming a wind tunnel by the multiple guide members to pass through the hollow portion 67 in the fixing unit 14, any additional unit such as an air duct for securing the wind passage, thereby reducing the number of parts, costs, and size in the apparatus.

The present patent application is not limited to an image forming apparatus that employs an in-body paper eject type. For example, the present patent application is also applicable to a monochrome copier, a monochrome laser printer, an inkjet printer, and an image forming apparatus that employs a tandem type with a direct transfer system in which a transfer sheet is conveyed on a transfer member for sequentially overlaying toner images. The present patent application is of course applicable to an image forming apparatus that employs an image carrier of an endless belt type. Specifically, a compact, lightweight image forming apparatus can achieve the above-described effects.

Although the invention has been described with respect to a specific embodiment for a complete and clear disclosure, the appended claims are not to be limited as shown in the above-described example embodiments and modified examples with reference to FIGS. 1 through 11 but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

The above-described exemplary embodiments are illustrative, and numerous additional modifications and variations are possible in light of the above teachings. For example, elements and/or features of different illustrative and exemplary embodiments herein may be combined with each other and/or substituted for each other within the scope of this disclosure. It is therefore to be understood that, the disclosure of this patent specification may be practiced otherwise than as specifically described herein.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. An image forming apparatus, comprising:

a transfer unit to transfer an image onto a transfer sheet;

a fixing unit disposed downstream from the transfer unit in a direction of conveyance of the transfer sheet,

the fixing unit fixing the image to the transfer sheet by application of heat and conveying the fixed transfer sheet to a further downstream portion of the image forming apparatus;

a discharging unit disposed downstream from the fixing unit in the direction of conveyance of the transfer sheet,

the discharging unit discharging the transfer sheet to an external portion of the image forming apparatus; and

multiple guide members disposed above the fixing unit to form a sheet conveyance path,

the multiple guide members comprising:

a first guide member; and

a second guide member, wherein the first and second guide members define a hollow portion therebetween, the second guide member includes a collecting portion, and the first guide member includes a liquid guide member, the sheet conveyance path including

a first path through which the transfer sheet is conveyed toward the discharging unit; and

a second path through which the transfer sheet from the first path is conveyed to receive another image on another side thereof,

wherein both the first path and the second path of the sheet conveyance path and the hollow portion are configured to enable an air current generated during image forming to pass therethrough, the first guide member is configured to form vapor condensate on an inside surface thereof from the air current in the hollow portion, the collecting portion is configured to collect liquid droplets of the vapor condensate, and the liquid guide member is configured to direct the formed vapor condensate to the collecting portion.

2. The image forming apparatus according to claim 1, wherein the liquid guide member includes a length, a width and a thickness, and wherein the liquid guide member increases in at least one of the width or the thickness along a length thereof.

3. The image forming apparatus according to claim 1, wherein the hollow portion extends to enable the air current to flow therein in a direction substantially perpendicular to the direction of conveyance of the transfer sheet.

4. The image forming apparatus according to claim 3, further comprising a side cover having electrical components mounted thereon,

wherein the air current includes vapor generated in a heated area of the fixing unit, and the air current that includes the vapor flows in a direction opposite the side cover having the electrical components mounted thereon.

5. The image forming apparatus according to claim 1, further comprising side covers disposed extending in a direction intersecting a longitudinal axis of the fixing unit at both ends of the fixing unit, wherein each of the side covers comprise multiple louvers that define multiple openings therein, and

the air current is generated by passing through the multiple openings of the side covers.

6. The image forming apparatus according to claim 1, further comprising:

side covers disposed extending in a direction intersecting a longitudinal axis of the fixing unit at both ends of the

fixing unit, wherein each of the side covers comprise multiple louvers that define multiple openings therein, and

the air current is generated by a forcedly generated flow of air substantially parallel to the longitudinal axis of the fixing unit.

7. The image forming apparatus according to claim **1**, wherein at least one of the first guide member and the second guide member includes a moisture absorbing material to absorb and store liquid droplets from condensation of vapor generated in the fixing unit within the hollow portion.

8. The image forming apparatus according to claim **1**, wherein the liquid guide members comprise a plurality of ribs, wherein each of the ribs is disposed on an inside surface of the first guide member.

9. The image forming apparatus according to claim **1**, wherein the collecting portion is defined by a guide rib and is included in the fixing unit.

10. The image forming apparatus according to claim **1**, wherein the multiple guide members form a wind tunnel to allow the air current to pass through the hollow portion.

11. An image forming apparatus, comprising:

means for transferring an image onto a transfer sheet;

means for fixing the image to the transfer sheet by application of heat and conveying the fixed transfer sheet to a further downstream portion of the image forming apparatus;

means for discharging the transfer sheet to an external portion of the image forming apparatus; and

means for forming a sheet conveyance path,

the means for forming a sheet conveyance path comprising:

a first guide member; and

a second guide member, wherein the first and second guide members define a hollow portion therebetween, the second guide member includes a means for collecting liquid droplets, and the first guide member includes a means for guiding the liquid droplets,

the sheet conveyance path including

a first path through which the transfer sheet is conveyed for operations of the means for discharging; and

a second path through which the transfer sheet from the first path is conveyed to receive another image on another side thereof,

wherein both the first path and the second path of the sheet conveyance path and the hollow portion defined by the means for forming are configured to enable an air current generated during image forming to pass therethrough, the first guide member is configured to form vapor condensate from the air current in the hollow portion, the means for collecting is configured to collect liquid drops of the vapor condensate, and the means for guiding is configured to direct the formed vapor condensate to the means for collecting.

12. The image forming apparatus according to claim **11**, wherein the air current includes vapor generated by heat from the means for fixing.

13. The image forming apparatus according to claim **12**, wherein the hollow portion extends to enable the air current to flow therein in a direction substantially perpendicular to the direction of conveyance of the transfer sheet.

14. The image forming apparatus according to claim **13**, further comprising a side cover having electrical components mounted thereon,

wherein the air current that includes the vapor flows in a direction opposite the side cover having the electrical components mounted thereon.

15. The image forming apparatus according to claim **11**, further comprising means for sending the air current into the image forming apparatus.

16. The image forming apparatus according to claim **15**, wherein the air current cools down the hollow portion.

17. The image forming apparatus according to claim **11**, wherein the means for forming the sheet conveyance path includes means for absorbing liquid droplets from condensation of vapor generated in the means for fixing.

18. The image forming apparatus according to claim **11**, wherein the means for forming forms a wind tunnel to allow the air current to pass through the hollow portion.

19. The image forming apparatus according to claim **11**, wherein the means for collecting is included in the means of fixing.

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